

**NATIONAL INSTITUTES OF HEALTH  
DIVISION OF SAFETY  
OCCUPATIONAL SAFETY AND HEALTH BRANCH**

**NIH Chemical Hygiene Plan**

Introduction

The use of hazardous chemicals in the laboratory is a necessary part of modern biomedical research science. In an effort to ensure the protection of laboratory personnel from the risks associated with the use of hazardous chemicals, the Occupational Safety and Health Administration (OSHA) has promulgated a standard entitled *Occupational Exposures to Hazardous Chemicals in Laboratories (29 CFR 1910.1450)*, referred to as the Laboratory Standard. Traditionally, OSHA health standards have been established to help protect industrial and manufacturing workers who may be exposed to significant quantities of, usually a few hazardous chemicals over a working lifetime. In laboratories, the use of hazardous chemicals is generally limited to small quantities used on a short-term basis and in operations where the chemicals and procedures change frequently. The Laboratory Standard demonstrates that OSHA has recognized the need for a standard that focuses on the unique nature of laboratory work.

The Laboratory Standard requires the development and implementation of a formal, written, and employee-accessible program referred to as a chemical hygiene plan. This plan, as defined by OSHA, must be "capable of protecting employees from health hazards associated with hazardous chemicals used in the laboratory."

The Laboratory Standard complements the provisions of the OSHA *Hazard Communication Standard (29 CFR 1910.1200)*. In accordance with the *Hazard Communication Standard*, the NIH has established a written program, the *NIH Hazard Communication Program (NIH-HCP)*. The NIH-HCP provides for the identification and inventory of hazardous chemicals, the availability of Material Safety Data Sheets (MSDSs) for these chemicals to employees, chemical container labeling, and employee training in hazard communication.

The *NIH Chemical Hygiene Plan* is consistent with the *NIH Hazard Communication Program*. Additionally, the Laboratory Standard supersedes the provisions of all other OSHA health standards, except for the permissible exposure limits found within the OSHA *Air Contaminants Standard (29 CFR 1910.1000)* and the substance-specific limits found in *Subpart Z, Toxic and Hazardous Substances*.

## I. Purpose

This plan outlines the information and services provided by the Occupational Safety and Health Branch (OSHB), Division of Safety (DS), on the safe use, storage and disposal of hazardous chemicals in the laboratory.

This program is written to meet the specific safety and health requirements outlined in 29 *CFR* 1910.1450, *Occupational Exposure to Hazardous Chemicals in Laboratories*.

## II. Scope

This plan applies to all laboratories and laboratory personnel of the NIH that use, store, or handle hazardous chemicals.

### Selected Definitions

Action Level: A concentration designated in 29 CFR part 1910 for a specific substance, calculated as an eight hour time-weighted average, that initiates certain required activities such as exposure monitoring and medical surveillance.

Chemical Hygiene Officer: A qualified individual who provides technical guidance in developing and implementing a chemical hygiene plan. At the NIH, the Chief of the Occupational Safety and Health Branch, DS, serves in this capacity.

Chemical Hygiene Plan: A written plan that establishes procedures and policies to protect laboratory personnel and other support staff from the potential adverse health effects associated with exposure to hazardous chemicals.

Designated Area: A predetermined and well labeled area in which carcinogens, reproductive toxins (teratogens/embryotoxins), or other chemicals with significant acute or chronic toxicity are used/kept in the laboratory.

Hazardous Chemical: A substance which is recognized to have a measurable potential for adverse (acute or chronic) health effects in humans. The *Hazard Communication Standard* provides additional guidance in determining the extent of the hazard presented by a chemical. For additional information, please refer to the *NIH Hazard Communication Program*.

IC: Institutes and Centers. An abbreviation used at the NIH that refers to organizational and management structure.

Laboratory/Laboratory Scale/Laboratory Use: A workplace in which relatively small quantities of hazardous chemicals are used in a nonproduction basis, and in which the tasks performed are designed to be easily and safely manipulated by one person.

Laboratory Personnel: Any person working in an NIH laboratory who handles or uses potentially hazardous chemicals. At the NIH, visiting scientists, guest researchers, special volunteers, students, and other similar personnel are included in the scope of the *Chemical Hygiene Plan*.

Particularly Hazardous Substances: These include "select carcinogens," reproductive toxins and substances which have a high degree of acute toxicity.

Permissible Exposure Limits (PELs): An exposure limit for OSHA regulated substances specified in *29 CFR part 1910.1000, Subpart Z, Toxic and Hazardous Substances*.

Reproductive Toxins: Chemicals that affect an individual's reproductive ability including chromosomal damage (mutations) and/or have an adverse effect on a fetus (teratogenesis).

Select Carcinogen: A substance regulated by OSHA and designated by the National Toxicity Program (NTP) or the International Agency for Research on Cancer (IARC) as having a moderate to high potential for causing cancer in animal models. This designation separates moderate-to-high risk carcinogens from those with slight to minimal risk when viewed in the context of their use in a laboratory.

Threshold Limit Value (TLV): An airborne concentration of a specific substance under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse health effects. TLVs are exposure guidelines established by the American Conference of Governmental Industrial Hygienists (ACGIH).

### **III. Responsibilities**

NIH Manual Issuance 1340, *NIH Occupational Safety and Health Management*, outlines the scope, objectives, and responsibilities of NIH staff in implementing the NIH Occupational Safety and Health Management Program. Additional information on the safe use of hazardous chemicals is provided in the *NIH Hazard Communication Program*.

The laboratory supervisor is responsible for providing health and safety information to his or her staff on the specific hazards found in the laboratory. In addition, an OSHB Safety and Occupational Health Specialist is assigned to each IC to assist laboratory workers in matters relating to chemical safety.

#### **IV. Information and Training**

The Occupational Safety and Health Branch provides information and training for laboratory researchers by providing three training courses that address chemical hazards in the laboratory.

A web based training course, “Introduction to Laboratory Safety”, covers basic laboratory safety in NIH research laboratories. This course introduces laboratory personnel to common hazards and exposure risks; including chemical, biological, radiological and physical hazards that are found in NIH research laboratories. All researchers complete this course upon arrival at the NIH. The web-based training program is available at [www.ors.od.nih.gov/labsafety](http://www.ors.od.nih.gov/labsafety).

A three-hour classroom course titled, “Laboratory Safety at the National Institutes of Health”, is also provided by the OSHB. Researchers attend this classroom course after completing the web-based course. This course provides additional training on the recognition and control of chemical, biological and physical hazards and provides information on NIH policies and procedures for working safely in research laboratories.

The OSHB also provides a course titled “Laboratory Safety Refresher Course” that reviews and provides updates for safety procedures and policies that govern laboratory safety at the NIH. NIH laboratory personnel, including summer students and summer research associates are required to complete this annual refresher course.

Contact the OSHB at 496-3353 for a list of upcoming program dates.

#### **V. Safe Work Practices with Hazardous Chemicals**

Laboratory supervisors should ensure that all personnel under their direction possess the requisite knowledge, training, and education to safely handle hazardous chemicals in the laboratory. All laboratory personnel are responsible for following the appropriate work practices when using hazardous chemicals.

- Minimize all chemical exposures and avoid underestimating the risk. Avoid unnecessary exposure to chemicals by any route.
- Keep food, beverages, cosmetics, and medication outside the lab.
- Protect your clothes and exposed skin by wearing laboratory coats and gowns. Open-toed shoes, sandals, shorts, and other apparel that leave skin exposed are not appropriate when handling potentially hazardous chemicals. Laboratory coats must not be worn outside the laboratory.

- Wear the appropriate gloves and eye/face protection whenever handling hazardous chemicals. These items should not be worn outside the laboratory.
- Ensure unimpeded access to safety showers and eyewash stations. Test flush eyewash stations weekly.
- Remove gloves carefully; thoroughly wash hands and forearms upon completion of work and before leaving the laboratory.
- Use a chemical fume hood when opening, pouring or handling hazardous chemicals.
- Conduct all work within the chemical fume hood at a distance of at least six inches behind the face opening and position the vertical sliding sash at the height specified on the certification sticker. Avoid blocking the airfoil, baffles and rear ventilation slot. Support large items with legs to minimize airflow disruption across the work surface. Minimize foot traffic around the hood during use, since passing in front of the hood during operation disrupts the airflow and may pull contaminants out of the hood. Do not use the fume hood for storage. By following these steps, the hood provides adequate containment for most chemical operations.
- Keep all doors to the laboratory closed when using the fume hood to ensure proper hood operation. Opened laboratory doors can adversely affect hood performance.
- Avoid the release of toxic substances in work spaces, especially in cold rooms and warm rooms, since they have contained, recirculated atmospheres.
- Never pipet by mouth.
- Transport laboratory chemicals using bottle carriers and suitable carts.
- Follow the established procedures for the decontamination and safe movement of scientific and medical equipment (*NIH Personal Property Management Guide, NIH Manual 26101-25-2*).
- Maintain continuous oversight of inexperienced personnel (high school students, etc.) working with potentially hazardous chemicals.
- Assist support personnel who may have to enter laboratories by removing hazardous materials from equipment/facilities to be serviced and forewarning them of the need for protective equipment or work practices, *etc.* Decontaminate

the equipment when possible. Provide the appropriate personal protective equipment.

- Follow the hazardous material spill procedure immediately in the event of a hazardous chemical spill.

### **Hazardous Material Spill Procedure**

1. Close the windows and doors and have everyone leave the room.
2. Call the Fire Department: 911 on-campus and 9-911 off-campus. The Fire Department provides medical attention/transportation to any exposed/injured employees and assists with the spill clean-up.
3. Wash all parts of the body that may have come in contact with the material with copious amounts of water and wait for the Fire Department to respond. Eyes should be flushed for 15 minutes. For minor exposures, rinse the area thoroughly and report to the Occupational Medical Service, Building 10, Room 6C06 (496-4411).
4. Do not reenter the room until the Fire Department or appropriate authorities determine that the area is safe.

### **Suggested Guidelines on the Safe Storage of Hazardous Chemicals in a Biomedical Research Laboratory**

The use of chemicals is an essential part of modern biomedical science. Many of the chemicals commonly used in the laboratory are not especially hazardous, but clearly there are exceptions.

In the laboratory, hazardous chemicals can be divided into four general categories: corrosive, flammable, reactive, and toxic. Usually, it is the immediate or obvious hazard that determines the classification of a particular chemical.

The safe storage of chemicals in the research laboratory and the cost associated with the proper disposal of chemical wastes are inextricably linked. According to the American Chemical Society, the cost associated with chemical disposal is an average of ten times the purchase price. In some cases, there are no acceptable waste disposal options. Controlling the increasing cost of proper chemical waste disposal and the inherent hazards of storing and working with hazardous chemicals requires rethinking many of the ways that we purchase, handle and store laboratory chemicals.

### **General Principles for the Purchase and Storage of Hazardous Chemicals in the Laboratory**

- Purchase only what you can reasonably expect to use during the next six months.
- Buy what you specifically need. It is often possible to buy premade molar and normal solutions, thereby reducing the likelihood of waste.
- Purchase containers in the smallest practical size. Although the cost may be slightly greater, significant savings are realized in reduced disposal cost and safer storage.
- Avoid glass containers. Purchase chemicals in plastic containers. If this is not possible, purchase shatter resistant plastic coated bottles.
- Read labels. Most of the information that you will need to handle and store the chemical is found on the manufacturer's label.
- Obtain and read the Material Safety Data Sheet (MSDS) for each of the chemicals that you use. Keep the MSDSs in a binder or folder for later reference.
- Rotate your chemical inventory. Indicate the date received and the date opened. Pay particular attention to the expiration date. Stored chemicals should be inspected periodically for deterioration and container integrity. For example, ether must be dated twice, once when it is received and again when it is opened. It should be discarded as chemical waste 6 months after opening.
- Label all chemical containers in the laboratory with the following information:
  - The name of the chemical or stock solution
  - The date of preparation
  - Your initialsThe identification and disposal of unlabeled chemical containers is very expensive.
- Keep all chemical containers off floors, carts, and electrical equipment.
- Segregate your chemicals into their respective hazard categories: corrosive, flammable, reactive, or toxic. Physically separate incompatible chemicals.
- Label the secondary storage containers and areas in which particularly hazardous chemicals may be used. These substances must be kept in a designated area.

- Store all laboratory chemicals below eye level. This simple task greatly reduces the likelihood of something falling from above, breaking, and contaminating the laboratory or causing injuries.
- Avoid placing any chemical container in direct sunlight, underneath a sink, or near heat sources.
- Store hazardous chemicals in cabinets with doors rather than on open shelves. Do not store on laboratory bench tops or in chemical fume hoods.
- Use and manage your chemical fume hood wisely. Do not store chemicals or equipment in the hood since these items can block the air slots and compromise the operation of the hood.
- Keep temperature-sensitive, volatile or flammable chemicals only in explosion-safe or explosion-proof refrigerators.
- Store all flammable chemicals in an approved flammable storage cabinet. If you need a flammable storage cabinet, call your IC Safety and Health Specialist for assistance (496-2346). Flammable storage cabinets come in various sizes.
- Purchase and use impact resistant bottle carriers which are available from the NIH Self-Service Stores.
  - The four liter carrier holds a single bottle (#6640-00-L01-1343).
  - The pint bottle carrier holds six one-pint bottles and is equipped with a domed lid and carrying handle (#6640-00-L01-1340).
- Follow the disposal guidelines provided by the NIH Waste Disposal Guide. Do not dispose of chemicals down the drain or by evaporation.
- Properly collect, tag and date waste. Keep chemical waste containers closed/sealed. Use drip pans under bulk waste collection containers to prevent spills.

Additional information on the safe storage of laboratory chemicals and assistance in determining chemical incompatibility is available from your IC Safety and Health Specialist by calling 496-2346.

## **VI. Control of Exposure to Hazardous Chemicals**

Hazardous chemicals may be used only in laboratory facilities specifically designed and engineered for such work. They may not be used in areas including (but not limited to)



offices, storage rooms, shared equipment areas, cold rooms, and other areas lacking the appropriate facilities and a proper means of ventilation.

Local exhaust ventilation systems such as fume hoods and slot hoods are the primary method of controlling exposures to hazardous chemicals in the laboratory. All fume hoods used at the NIH must meet the NIH fume hood design specification. ICs may purchase fume hoods only through the Division of Engineering Services. Any alteration affecting a local exhaust ventilation system or associated ductwork must be approved by the OSHB prior to the system's modification.

Ductless chemical fume hoods are not to be used in NIH laboratories. Captured organic vapors begin to desorb from ductless chemical fume hood charcoal filters shortly after adsorption occurs, and some degree of breakthrough or failure to capture occurs during introduction of vapor into the hood.

The need for regular monitoring of airborne contaminants in the laboratory is not usually justified or practical, assuming that fume hoods and other appropriate methods of containment are used properly, safe work practices are followed judiciously, and all laboratory and support personnel practice good personal hygiene.

Contact the IC Occupational Safety and Health Specialist at 496-2346 for assistance when a concern arises over potential exposure to a laboratory chemical. Specialized monitoring and chemical exposure determination is available from the Industrial Hygienists of the OSHB.

The Laboratory Standard requires that exposures to OSHA regulated chemicals in the laboratory must not exceed the Permissible Exposure Limits (PELs) or the recommended Threshold Limit Values (TLVs) when there is no PEL.

#### Special Note on Pregnancy

Personnel who are pregnant or considering becoming pregnant may have special concerns about working with chemicals that have potential reproductive hazards. Such concerns can be discussed with her supervisor, the OSHB IC Safety and Health Specialist (496-2346), and/or the staff of the Occupational Medical Service (496-4411).

## **VII. Personal Protective Equipment**

Personal protective equipment (PPE) is an essential means of worker protection and can be used in combination with physical containment devices such as fume hoods. The OSHB IC Safety and Health Specialist can perform a workplace hazard assessment to identify any hazards which are present, or likely to be present, during a particular operation and provide

information and guidance on the selection and use of personal protective equipment. Information on the selection and use of PPE is also presented in the NIH Laboratory Safety training courses.

Various types of protective equipment, including chemical resistant gloves, aprons, eye and face protection, *etc.*, are available from the NIH Self Service Stores and numerous vendors. Consult the *NIH Supply Catalog* for more information or call your IC Safety and Health Specialist for additional advice (496-2346).

Disposable gloves are one of the most commonly used types of PPE. The proper use of disposable gloves provides protection to the wearer by providing a barrier to potential hazards, and product protection by protecting experimental materials from enzymes or DNA on the glove wearer's hands. Select the correct glove for the task. Certain gloves do not afford appropriate chemical protection. All laboratory personnel are responsible for following the appropriate work practices when using disposable gloves.

- Remove your gloves carefully; thoroughly wash your hands and forearms upon completion of work and before leaving the laboratory. Do not reuse disposable gloves.
- Disposable gloves that become visibly contaminated, or are suspected of being contaminated with hazardous materials, should be replaced as soon as possible. Gloves contaminated with hazardous materials should be disposed of in accordance with the NIH Waste Disposal Guide. All used disposable gloves shall be treated as potentially contaminated and disposed of appropriately.
- Gloves shall not be worn in common-use areas except in emergency situations or in rare situations when conditions warrant their use. Common-use areas are those areas outside laboratory rooms and animal holding and procedure areas.

Some types of gloves are reusable. These gloves should be inspected prior to each use and replaced as necessary. Reusable gloves include those designed to protect the user from the temperature extremes encountered when handling materials that are either hotter or colder than the normal laboratory environment.

Shatter proof prescription safety glasses that provide protection from flying objects are available through the Occupational Medical Service (496-4411). Goggles and a face shield should be worn if there is a potential for a chemical splash.

Respirators must not be used in the laboratory without prior approval by the OSHB. Laboratory supervisors are not authorized to select or recommend the use of respiratory protection, regardless of the type. Call your IC Safety and Health Specialist if you feel that you may need respiratory protection. It is the policy of the NIH to provide, at no cost to the

employee, respiratory protection when: the best available engineering controls fail to adequately reduce employee exposure to respiratory hazards; substitution of respiratory hazards with less hazardous elements is not feasible; modifications in hazardous operations fail to reduce exposures to below regulated or acceptable levels.

The criteria for the selection, fitting, and use of respirators is described in the OSHA *Respiratory Protection Standard (29 CFR 1910.134)*.

### **VIII. Precautions to be Taken When Working with Particularly Hazardous Substances**

These substances include select carcinogens, reproductive toxins, and chemicals that have a high degree of acute toxicity. Substance specific information is contained in Material Safety Data Sheets and is also available through the Technical Assistance Section of the OSHB (496-3353).

The laboratory supervisor is responsible for ensuring that appropriate precautions are taken when working with hazardous chemicals.

#### **Safe Work Practices with Particularly Hazardous Substances**

- Control access to the laboratory through the use of appropriate signs that warn of the hazards and indicate the precautions or approvals necessary for entry. Contact your IC Occupational Safety and Health Specialist for assistance.
- Contact the Occupational Medical Service at 496-4411 to determine if medical surveillance may be warranted if toxicologically significant quantities of a particularly hazardous substance are used on a routine or frequent basis.
- Maintain an accurate record of the workers who use these substances and the amounts used and stored in the laboratory.
- Contact the Environmental Protection Branch at 496-7990 for assistance with specialized waste disposal.
- Keep particularly hazardous substances in a secondary container to help prevent breaks and spills. This secondary container should be opened only inside a chemical fume hood.
- Attach a suitable hazard warning label to this secondary container to alert others of the chemical contained therein and the need for special precautions, for

example: "Warning - Cancer Hazard" or "Highly Toxic."

- Protect work surfaces from contamination through the use of disposable, absorbent, plastic backed paper. Replace contaminated paper as necessary and handle as hazardous waste.
- Use additional containment devices (such as shielding or protective filters) to safely handle, store or protect equipment and workers when using these chemicals.
- Wear appropriate personal protective equipment including: gloves, eye/face protection, and other protective apparel or equipment as needed. Examples include: impervious gowns, aprons or gauntlets.
- Remove all protective apparel and thoroughly wash hands, forearms, face and neck upon completion of work and before leaving the laboratory.

## **IX. Prior Approval for Work with Certain Hazardous Chemicals**

Prior approval is required when working with certain hazardous chemicals and when there is a significant risk of exposure. This oversight process is followed when the proposed work involves hazardous chemicals that meet one or more of the following criteria. The chemicals to be used:

- Can cause severe, acute, or lethal effects upon exposure by any route in quantities of 50 ug/kg or less.
- Are highly unstable or, when combined with other compounds in the procedure, are explosive.
- May undergo chemical or physical changes during routine use and generate by-products that may overcome standard control measures or may penetrate available personal protective equipment to cause severe acute or lethal injuries.
- Have been determined by the Division of Safety to present a unique hazard or are used in an operation that requires approval above the level of the laboratory supervisor.

When one or more of the criteria above are met, the project Principal Investigator (PI) must develop a specific written safety protocol and submit it to the OSHB IC Safety and Health Specialist for review prior to beginning work. This safety protocol should include: (1) a thorough description of the chemical(s) to be used - including the potential physical and health effects, (2) a step-by-step review of the work to be performed, (3) a list of the available engineering controls and personal protective equipment, (4) provisions for proper labeling,

storage, and waste disposal, and (5) decontamination procedures. Evidence of employee training on the established safety protocol must be provided to the OSHB. This information shall include a review of the safety protocol described above, expected actions in the event of an emergency, the date the training was provided, and the name and last four digits of the social security number of personnel trained. Assistance in laboratory safety training is available from the OSHB Safety Training Officer at 496-3353.

The oversight process for work with hazardous chemicals ensures that the proposed activities are conducted by specifically trained personnel in accordance with an approved safety protocol.

If the Principal Investigator (PI) and the OSHB fail to resolve a significant issue regarding a protocol, the matter will be referred to the IC Scientific Director and/or the NIH Occupational Safety and Health Committee, as appropriate.

## **X. Chemical Hygiene Plan Evaluation and Record Keeping**

The NIH Chemical Hygiene Plan is reviewed annually and updated as needed by the Division of Safety and the NIH Occupational Safety and Health Committee. Comments and suggestions on the improvement of this document should be directed to the Chief, OSHB (496-2960).

Training records are maintained by the OSHB. Individuals may request their training records by contacting the OSHB Training Officer (496-3353).

## **XI. Services Provided by the NIH Division of Safety**

The NIH Division of Safety (DS) conducts a number of programs focusing on laboratory safety and the proper handling of chemicals. Contact the OSHB IC Safety and Health Specialist for additional information regarding these programs or go to the Division of Safety website <http://www.nih.gov/od/ors/ds>.

### **Occupational Safety and Health Branch**

The Occupational Safety and Health Branch, DS, offers a number of laboratory support functions:

- Reviews safety protocols for work involving certain hazardous chemicals to ensure that the proposed activities are conducted by trained personnel using the proper safety equipment.

- Conducts surveys of work locations to identify practices or procedures that may pose potential hazards to the health and safety of personnel.
- Identifies potentially hazardous situations in work areas and recommends appropriate control measures.
- Reviews designs/drawings of all local exhaust systems considering every component of the system, including the shape and placement of hoods, size and length of ductwork, size and position of the exhaust fan, and the siting of the exhaust system in the laboratory and building. All applications employing local exhaust ventilation must be reviewed by OSHB.
- Provides expert advice and guidance on the proper selection, use, and functioning of protective equipment.
- Oversees a comprehensive testing and certification program for safety related ventilation equipment including: chemical fume hoods, local exhaust systems, biological safety cabinets, and other containment systems.

### **Environmental Protection Branch**

The Environmental Protection Branch, DS, offers a number of services related to the treatment and disposal of non-radioactive waste:

- Oversees all NIH non-radioactive chemical, medical, and solid waste handling, treatment, and disposal activities.
- Conducts research regarding alternate systems for the management of chemical waste.
- Monitors NIH activities for compliance with Federal, State, and Local environmental regulations and the impact of those activities on the environment.

### **Occupational Medical Service**

The NIH Occupational Medical Service, DS, offers a comprehensive occupational medical care program to NIH employees:

- Provides emergency medical treatment in the event of a spill or other unusual event resulting in an acute chemical exposure.

- Evaluates any employees who develop signs or symptoms associated with a possible physical or chemical exposure in the laboratory.
- Provides periodic medical surveillance when chemical exposure monitoring data reveal an exposure at or above the action level for an OSHA regulated substance.
- Maintains employee medical records.